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Hydrogeological Features and Sustainable Use of Geothermal Resources: Selected Case Studies in Italy

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Abstract - Within the framework of the activities aimed at studying current and future exploitation and the related sustainability of geothermal resources, and considering the key role hydrogeology plays in the study of geothermal systems and design of installations, in October 2012 the Working Group **IDROGEOTER** was set-up within the IAH (International Association of Hydrogeologists) Italian Chapter. The first activity of **IDROGEOTER**'s workplan is the analysis of state of the art in current use of low-to high enthalpy geothermal resources in Italy and of the hydrogeological settings resulting from features (e.g.: hydrostratigraphy, hydraulic and hydrodynamic conditions, hydrogeochemistry, ...) influencing the availability of the resource and the potential of the systems. Detailed studies supporting the possible optimization of the use of geothermal resources, carried out in different areas (see figure) and under different hydrogeological conditions in Italy, are described in the paper. In the **Piedmont** Region (NW Italy) several experimental sites have been investigated in order to assess the potential subsurface effects of open-loop Groundwater Heat Pumps (GW-HPs) plants for the cooling and heating of buildings. A comparison between field measures and numerical modelling results reveals that the most important aquifer parameters affecting the developing of the Thermal Affected Zone (TAZ) around the injection wells are those related to advective heat transfer. The **Lombardy** Region (N Italy) is currently the most populated and industrialized region in Italy and therefore the area where the highest number of GWHP plants (open and closed loop) are installed, from which a representative sample will be selected with the objective of identifying the critical hydrogeological factors contributing both to the geothermal potential and to a sustainable use of the resource. In the **Veneto** Region (NE Italy), the Euganean Geothermal Field is the most important thermal field in northern Italy (about 250 active wells) and the thermal waters (65-86 °C) are mainly used for spas; recently, a new conceptual model of the Euganean Geothermal System has been proposed and tested in a numerical model; with regard to low enthalpy, studies on sites potentially suitable for closed-loop and open-loop systems, together with data from automated monitoring of several wells, could be used for advanced analysis of different hydro-geothermal systems. Research activities in the **Lazio** Region (Central Italy) focus also on low enthalpy and are specifically aimed at the mapping of the geothermal potential of aquifers, and at pilot studies of sites characterized by gravel aquifers, alluvial Holocene deposits of the Tevere River and alluvial pre-volcanic Pleistocene deposits. In the **Campania** Region (S Italy - Mondragone plain), in the framework of the geothermal exploration programme "VIGOR" (Evaluation of Geothermal Potential in Convergence Region), a groundwater balance, verifying the recharge area of thermal springs (temperature 33-54 °C) connected to a large carbonate aquifer, has permitted the identification of the most suitable area in which to drill a geothermal well. In the **Apulia** Region (SE Italy) the thermal field trends consequent to groundwater advection and the influence of seawater intrusion have been reconstructed for two karstic coastal aquifers (Murgia and Salento) at various elevation between -5 and -100 m amsl. These reconstructions are intended to provide required base knowledge for correctly implementing low enthalpy HP plants in the saturated zones. Further studies and inventory of data and applications will be part of the activities of **IDROGEOTER**, which will also include the preparation of a proposal of guidelines for hydro-geothermal studies.

